

# Analysis of volatile organic compounds released from chicken eggs during incubation

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## Introduction

- It is currently impossible to tell the sex of a chicken embryo prior to hatching without damaging the egg or otherwise jeopardizing the chances of survival
- The inability to noninvasively determine the chicken's gender *in-ovo* is both an economical and ethical concern for the egg industry
- Some studies have shown that the volatile organic compounds (VOCs) released during incubation may differ between sexes

## Motivation & Objective

- Desire to find noninvasive methods for determination of sex of chicken embryos *in-ovo*
- Potential for more ethical timing of elimination of unwanted chickens
- Study of VOCs from the eggs by proton transfer reaction-mass spectrometry (PTR-MS) and machine learning algorithms

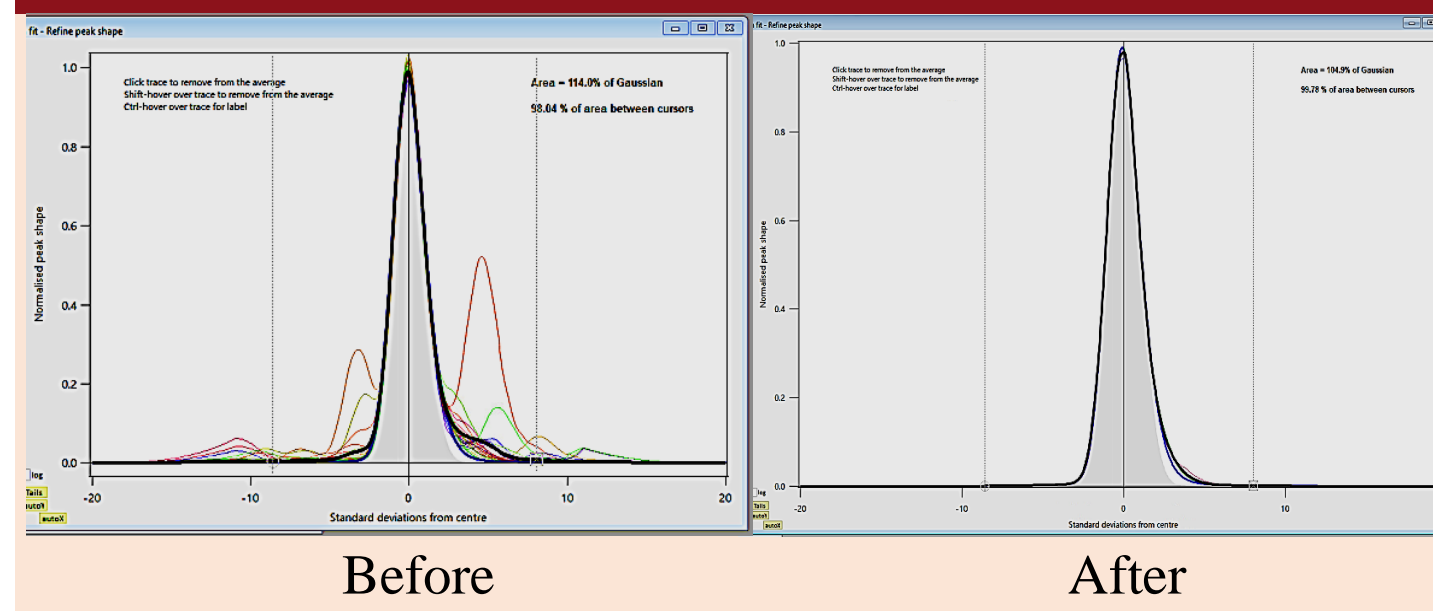
## Hypothesis

- The components of chicken egg VOCs released during incubation differ between male and female embryos, and the analysis of VOCs from individual eggs can lead to determination of sex using machine learning algorithms that can detect distinctions between sexes using learned patterns

## Methods

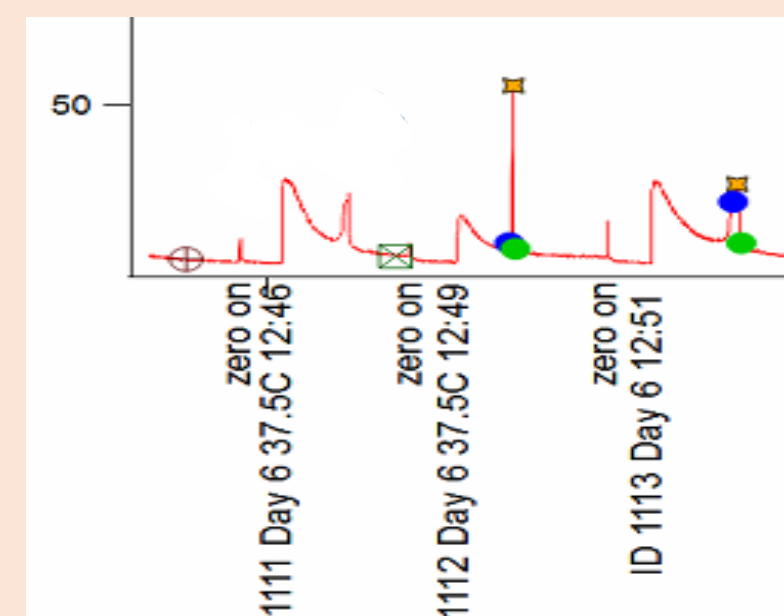
- Eggs were contained within individual septa jars during incubation to prevent contamination of VOC measurements
- Measurements were made for individual eggs using PTR-MS equipment from ToFwerk
- Raw VOC data was processed using ToFwerk's analysis software to calibrate and determine the volatile compounds present in the samples
- Machine learning to be used to find patterns between sexes

## Elimination of Outliers



## Peak Integration

- Peaks measured during VOC collection were manually marked using experimental notes and then integrated using a custom designed code to determine the areas of the curves with peaks



## Results

- The potential biomarkers for sex identification are:
  - benzaldehyde ( $C_7H_6O$ )
  - acetophenone ( $C_8H_8O$ )
  - 2-undecanone ( $C_{11}H_{22}O$ )
  - 2-decanone ( $C_{10}H_{22}O$ )
  - 2-nonanone ( $C_9H_{18}O$ )
  - phenol ( $C_6H_6O$ )
- The DNA results on the sex of the embryos are not currently able to be processed, so no hypothesis on the distinctions between male and female VOCs may be made at this time.

## Discussion

- The method of PTR-MS can be used to determine the chemical formula of the compounds present, however several of the formulas have possible isomers. Further steps will be taken to narrow down which of the isomers are present in the VOC measurements from the eggs.
- Upon completion of the embryo DNA tests, VOC data will be studied for patterns between sexes.

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[www.abbaslab.com](http://www.abbaslab.com)